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THE JOURNAL OF ENTOMOLOGY AND ZOOLOGY

William A. Hilton, Editor

Claremont, California, U. S. A.

Preliminary List of Birds From the Claremont-Laguna Region

This list is compiled from many local sources. The earliest records of the Department of Zoology of Pomona College were by Illingsworth, later by Chas. Metz, by Leon L. Gardner and others. There is also included the local records of Wright M. Pierce, and Halsted White. The drawings are all from bird skins from the collections of Pierce and White and from the Department of Zoology of Pomona College. The drawings are by Miss Hazel Burnham. For criticisms, suggestions and much valuable material we have especially to thank Mr. Halsted White and Mr. Wright M. Pierce. Grinnell's "Distributional List of the Birds of California," was used as a basis in the use of the names.

In the list the initials after a record or statement denotes the authorship. Unless otherwise indicated the specimens drawn were males.

The figures on the last two plates are reduced one-half. Other figures are reduced one-third, the figures of the pelicans, condor and vulture are reduced more.

Aechmophorus occidentalis Law. Western Grebe. H.W.

Colymbus nigricollis californicus Heerm. American Eared Grebe. H.W. Seen occasionally in winter on ponds near Santa Ana river near Corona. W.M.P. Pl. I. Fig. 1.

Podilymbus podiceps Linn. Pie-billed Grebe. H.W. Seen at times near fresh water ponds at Corona. W.M.P. Pl. I. Fig. 2.

Gavia immer Brun. Balboa. L.L.G. Common Loon.

Gavia pacifica Lawr. Laguna Beach. L.L.G. Pacific Loon.

Ptychoramphus aleuticus Pall. Cassin Auklet. H.W.. Pl. I. Fig. 3.

Uria troille californica H. Bry. California Murre. One taken in winter at Newport Beach by A. Van Rossen. W.M.P.

Larus glaucescens Naum. Glaucous-winged Gull. Seen. H.W.

Larus occidentalis Aud. Western Gull. Laguna, Balboa. H.W. and L.L.G. Noted at all seasons along the coast, most commonly in fall and winter. W.M.P. Pl. I. Fig. 4.

Larus delawarensis Ord. Ring-billed Gull. Metz and H.W. Pl. I. Fig. 6.

Larus heermanni Cassin. Heermann Gull. Balboa. L.L.G. Pl. I. Fig. 5.

Larus philadelphia Ord. Bonaparte Gull. H.W. Pl. I. Fig. 7. Noted in flocks in spring, Nigger Slough, Los Angeles county. W.M.P.

Sterna paradisæa Brun. Arctic Tern. Near Laguna Beach, May 1, 1915. H.W. Pl. I. Fig. 8.

Sterna antillarum Less. Least Tern. H.W. Laguna Beach. L.L.G. Breeding on beach near Newport, June, 1916. W.M.P. Pl. I. Fig. 9.

Hydrochelidon nigra surinamensis Gmel. Black Tern. H.W. One taken on fresh water pond near Corona, May 18, 1915. W.M.P. Pl. I. Fig. 10.

Puffinus griseus Gmel. Dark-bodied Shearwater. Ten or twelve miles from shore near Laguna Beach, in flocks over schools of fish. H.H.N.

Phalacrocorax auritus albociliatus Ridg. Farallon Cormorant. Seen H.W. Pomona Davenport. Found at all times on reservoirs near Claremont; also seen in fall and winter on fresh water ponds near Corona. W.M.P. Pl. I. Fig. 11.

Pelecanus erythrorthynchos Gmel. White Pelican. Often seen on migrations. H. W., W.M.P., L.L.G. Pl. I. Fig. 13.

Pelecanus californicus Ridg. California Brown Pelican. Often seen at Laguna Beach. Pl. I. Fig. 12.

Mergus serrator Linn. Red-breasted Merganser. Balboa. H.W. L.L.G. Pl. I. Fig. 14.

Lophodytes cucullatus Linn. Hooded Merganser. Specimen, no record. Pl. I. Fig. 15.

Anas platyrhynchos Linn. Mallard. H.W. Fairly common in fall and winter, lowlands near Corona and Santa Ana river. Many specimens taken. A few pairs possibly remain and breed in the same region. W.M.P. Pl. II. Fig. 1.

Chaulelasmus streperus Linn. Gadwall. Seen H.W. Rather rare visitant to fresh water ponds near Corona. W.M.P.

Mareca americana Gmel. Baldpate. H.W. Rather abundant, certain winters, fresh water ponds near Corona, often in large flocks. W.M.P. Pl. II. Fig. 2.

Nettion carolinense Gmel. Green-winged Teal. H.W. Abundant some years, November to March. Always common. Pl. II. Fig. 3.

Querquedula cyanoptera Vieil. Cinnamon Teal. Laguna Beach. L.L.G., H.W. Fairly abundant early fall, less common in mid-winter. Scattering pairs breed in marshes near Corona. W.M.P. Pl. II. Fig. 4.

Spatula clypeata Linn. Shoveller. H.W. Abundant, fall and winter Santa Ana river and ponds. W.M.P. Pl. II. Fig. 5.

Dafila acuta Linn. Pintail. H.W. Very abundant from Oct. 15 to Dec. 1, or later. Large flocks seen in spring, Corona, Santa Ana river. W.M.P. Pl. II. Fig. 6.

Marila americana Eyt. Redhead. H.W. Occasionally taken on fresh water ponds near Corona. W.M.P. Pl. II. Fig. 7.

Marila valisineria Wil. Canvas-back. H.W. Occasionally taken on ponds near Corona. W.M.P. Pl. II. Fig. 8.

Marila marila Linn. Greater Scaup Duck. H.W. Pl. II. Fig. 9.

Marila collaris Donov. Ring-necked Duck. One taken Dec. 12, 1915, fresh water pond near Corona. (Recorded in Condor.) W.M.P.

Charitonetta albeola Linn. Buffle-head. Seen H.W. Rare, seen once on pond near Corona. W.M.P. Pl. II. Fig. 10.

Oidemia deglandi Bonap. White-winged Scoter. H.W. Pl. II. Fig. 11.

Erismatura jamaicensis Gmel. Ruddy Duck. Laguna Beach Gardner. H.W. Common in small flocks, pairs or individuals, fall and winter, fresh water ponds near Corona. W.M.P. Pl. II. Fig. 12.

Dendrocygna bicolor Vieil. Fulvous Tree Duck. Claremont, June 30, 1897. Illingsworth. Pl. II. Fig. 13.

Plegadis guarauna Linn. White-faced Glossy Ibis. Rather uncommon. In Oct., 1916, two birds seen on fresh water ponds near Corona. W.M.P.

Botaurus lentiginosus Montag. American Bittern. H.W. Common in marsh and lowland near Corona, Chino, El Monte. Seen as late as April. Probably nests. W.M.P. Pl. II. Fig. 14.

Ardea herodias hyperonca Oberh. California Great Blue Herron. H.W. Laguna Beach. L.L.G. Breeding colony near Laguna Beach, April 23, 1917, eight or ten nests with young one-fourth to one-half grown. One nest with two eggs. Often seen near Corona and Chino standing in barley or beet fields. W.M.P. Pl. II. Fig. 15.

Butorides virescens anthonyi Mear. Anthony Green Herron. H.W. Several seen in San Dimas Canyon in early spring; also seen near Corona in river bottoms. W.M.P. Pl. II. Fig. 16.

Nycticorax nycticorax naevius Bodd. Black-crowned Night Herron. H.W. Claremont. L.L.G. In spring in Santa Ana river bottoms near Corona. W.M.P. Pl. II. Fig. 17.

Rallus obsoletus Ridg. California Clapper Rail. In swampy tracts about Balboa. H.H.N.

Rallus virginianus Linn. Virginia Rail. H.W. Many records, fall, winter, spring, near Chino and Corona. W.M.P. Pl. III. Fig. 1.

Porzana carolina Linn. Sora Rail. H.W. Same records as Virginia Rail. W.M.P. Pl. III. Fig. 2.

Coturnicops noveboracensis Gmel. Yellow Rail. One record, Corona. Pierce Condor XVI, 1914. W.M.P.

Gallinula galeata Licht. Florida Gallinule. Corona. H.W. Seen at times in fall near Corona. W.M.P. Pl. III. Fig. 3.

Fulica americana Gmel. Coot. H.W. Laguna Lakes. L.L.G. Very abundant near Corona. Breeds. W.M.P. Pl. III. Fig. 4.

Phalaropus fulicarius Linn. Red Phalarope. One record from near Corona. W.M.P.

Steganopus tricolor Vieil. Wilson Phalarope. H.W. Three records from fresh water ponds near Corona. W.M.P. Pl. III. Fig. 5.

Himantopus mexicanus Mull. Black-necked Stilt. H.W. Several in spring on fresh water ponds near Corona. W.M.P. Pl. III. Fig. 6.

Gallinago delicata Ord. Wilson Snipe. H.W. Common in fall and winter and spring, in wet fields near Corona and Chino. W.M.P. Pl. III. Fig. 7.

Macrorhamphus griseus scolopaceus Say. Long-billed Dowitcher. Balboa. L.L.G. Pl. III. Fig. 8.

Pisobia minutilla Vieil. Least Sandpiper. Long Beach. Metz. Flocks of twelve or fifteen seen at times on ponds near Corona. W.M.P. Pl. III. Fig. 9.

Ereunetes mauri Cab. Western Sandpiper. H.W. Long Beach. Metz. Pl. III. Fig. 10, female.

Calidris leucophaea Pall. Sanderling. H.W. Pl. III. Fig. 12.

Totanus melanoleucus Gmel. Greater Yellow-legs. H.W. Pl. III. Fig. 13. Corona ponds, fall and winter. W.M.P.

Catoptrophorus semipalmatus inornatus Brew. Western Willet. H.W. Pl. III. Fig. 14.

Heteractitis incanus Gmel. Wandering Tattler. Taken near Laguna Beach by H.W.

Actitis macularius Linn. Spotted Sandpiper. H.W. Fall, winter, spring; rocky coves near Laguna Beach. W.M.P. Pl. III. Fig. 11.

Numenius americanus Bech. Long-billed Curlew. H.W. Seen at Balboa in spring. W.M.P. Pl. III. Fig. 17.

Numenius hudsonicus Lath. Hudsonian Curlew. H.W. Balboa. L.L.G. Fall, winter, spring, Balboa, Newport, Laguna. W.M.P. Pl. III. Fig. 16.

Squatarola squatarola Linn. Black-bellied Plover. H.W. Same localities as last, not so abundant in winter. W.M.P. Pl. III. Fig. 18.

Oxyechus vociferus vociferus Linn. Killdeer. H.W. Laguna Gardner. Near Claremont, fall; Chino, Corona, Newport. Breed near Chino, Newport. W.M.P. Pl. III. Fig. 19.

Aegialitis semipalmata Bonap. Semipalmated Plover. Balboa. L.L.G.

Aegialitis nivosa Cass. Snowy Plover. H.W. Long Beach. Metz. Several pairs near Newport, 1916. Near Balboa at all seasons. W.M.P. Pl. III. Fig. 20.

Arenaria melanocephala Vig. Black Turnstone. H.W. Several records near Laguna. W.M.P. Pl. III. Fig. 21.

Oreortyx picta plumifera Goul. Mountain Quail. H.W. Recorded from Brown's Flats, San Antonio Canyon, Camp Baldy, Bear Flats, Palmers Canyon. W.M.P. Pl. III. Fig. 23.

Lophortyx californica vallicola Ridg. Valley Quail. H.W. Claremont, Santa Ana, Laguna, Lytle Creek up to 5000 ft. Breeds in April, 10 to 24 eggs. W.M.P. Pl. III. Fig. 22.

Colomba fasciata fasciata Say. Band-tailed Pigeon. Oct. 1916. H.W. Claremont. Metz. Abundant in San Dimas Canyon at certain seasons, usually in large flocks, less common than formerly. Found at Glen Ranch in Lytle Creek. W.M.P. Pl. III. Fig. 25.

Zenaidura macroura marginella Woodh. Western Mourning Dove. H.W. Quite abundant, less so than formerly. W.M.P. Pl. III. Fig. 24.

Gymnogyps californianus Shaw. California Condor. One specimen in the department, supposed to have been obtained from hills near Pomona about fifteen years ago. Pl. IV. Fig. 1.

Cathartes aura septentionalis Wied. Turkey Vulture. L.L.G., H.W. Claremont, Chino, Laguna. Abundant. W.M.P. Pl. IV. Fig. 1.

Circus hudsonius Linn. Marsh Hawk. H.W. Noted from foothills near Etiwanda to Santa Ana river bottoms near Santa Ana. Breeding record near Corona. W.M.P. Pl. IV. Fig. 3.

Accipiter velox Wil. Sharp-shinned Hawk. H.W. Common fall, winter and early spring, mountains to lowlands. W.M.P. Pl. IV. Fig. 4.

Accipiter cooperi Bonap. Cooper Hawk. H.W. Resident in small numbers; most abundant in fall and winter. Breeds in mountain canyons. Recorded from Lytle Creek, San Gabriel, etc. W.M.P. Pl. IV. Fig. 5.

Buteo borealis calurus Cass. Western Red-tailed Hawk. H.W., Illingworth, Metz. Common breeding from coast to mountains. W.M.P. Pl. IV. Fig. 7.

Buteo lineatus elegans Cass. Red-bellied Hawk. H.W. Probably becoming scarcer every year. A few pairs still breed in river bottoms near Corona. W.M.P. Pl. IV. Fig. 6.

Buteo swainsoni Bonap. Swainson Hawk. Found breeding in several instances in river bottom near Corona, also near Chino. Large flocks often seen flying north or south. W.M.P. Pl. IV. Fig. 8.

Archibuteo ferrugineus Licht. Ferruginous Rough-legged Hawk. Rather uncommon. One taken near Corona. Another seen in fall of 1916. W.M.P.

Aquila chrysaetos Linn. Golden Eagle. H.W., Metz. In high mountains. W.M.P. Pl. IV. Fig. 9.

Haliaeetus leucocephalus leucocephalus Linn. Southern Bald Eagle. Near Laguna and San Pedro. W.M.P., L.L.G.

Falco mexicanus Schl. Prairie Falcon. H.W. Not common, fall and winter near Chino. W.M.P. Pl. IV. Fig. 10.

Falco columbarius columbarius Linn. Northern Pigeon Hawk. Rather uncommon. Several taken, all probably this form. Pl. IV. Fig. 11.

Falco sparverius sparverius Linn. American Sparrow Hawk. H.W., L.L.G., Metz, Illingsworth. From the mountains to the sea. W.M.P. Pl. IV. Fig. 12, male. Fig. 13, female.

Pandion haliætus carolinensis Gmel. American Osprey. Between Laguna and Balboa, summer, 1916. H.H.N. Seen near Newport. W.M.P.

Aluco prantincola Bonap. American Barn Owl. Metz., L.L.G., H.W. Vefy common, San Dimas Canyon, Claremont, Chino, near Corona, Upland, Laguna. Nests in holes in trees or rocks or in buildings. Eggs from February to May. W.M.P. Pl. IV. Fig. 14.

Asio wilsonianus Less. Long-eared Owl. H.W., Metz. June 7, 1909. One record from Indian Hill, Claremont. Several pairs nesting in willow bottoms near Corona, April, 1915 to 1917. W.M.P. Pl. IV. Fig. 15.

Asio flammeus Pontop. Short-eared Owl. H.W. Hills near Pomona, Nov. 10. Near Corona, Nov. 3. Near Ontario in grain field, Nov. 2. W.M.P. Pl. IV. Fig. 16.

Strix occidentalis occidentalis Xan. Southern Spotted Owl. One record from San Gabriel Canyon, May 1, 1916. W.M.P.

Otus asio quercinus Grin. Southern California Screech Owl. Illingsworth, H.W. Abundant, Claremont, resident breeding. San Dimas and San Antonio Canyons, many records. W.M.P. Pl. IV. Fig. 17.

Bubo virginianus pallescens Stone. Western Horned Owl. One record. Found dead at mouth of San Antonio Canyon, Jan. 10, 1915. W.M.P.

Bubo virginianus pacificus Cass. Pacific Horned Owl. Pair seen at Laguna, 1917; San Antonio Canyon, 1914. Breeding in San Dimas Canyon, Feb. and March, 1917. W.M.P. Pl. IV. Fig. 18.

Speotyto cunicularia hypogæa Bonap. Burrowing Owl. Illingsworth, 1902; Metz, H.W. Near Santa Ana and Irvine. Abundant in fields near Chino and Corona, nesting. Near Claremont, nesting. Nigger Slough, nesting. W.M.P. Pl. IV. Fig. 19.

Glaucidium gnoma californicum Sclat. California Pigmy Owl. One record, San Antonio Canyon. W.M.P. Pl. IV. Fig. 20.

Geococcyx californianus Less. Road Runner. H.W. Claremont. Illingsworth, '96; L.L.G. Laguna, 1914. Formerly much more common. W.M.P. Pl. V. Fig. 1.

Coccyzus americanus occidentalis Ridg. California Cuckoo. Seen H.W. Rather uncommon. Several individuals seen at Corona in willows; one set of three eggs found near Chino. Pl. V. Fig. 2.

Ceryle alcyon caurina Grin. Western Belted Kingfisher. H.W. Noted in migration near Claremont, San Gabriel Canyon, San Antonio Canyon, Glen Ranch, Santa Ana river near Corona. W.M.P. Seen in Pudding Stone Canyon. L.L.G. Pl. V. Fig. 3.

Dryobates villosus hyloscopus Canab. and Hein. Cabinas Woodpecker. H.W. Common in nesting season in higher mountains. Taken in fall in Santa Ana river bottoms and also near El Monte. W.M.P. Pl. V. Fig. 4. Bright red patch on head.

Dryobates pubescens turati Malhe. Willow Woodpecker. H.W. Common in willow bottoms near Corona in spring; also El Monte. One taken in San Antonio and one in San Dimas Canyons in the fall. W.M.P. Pl. V. Fig. 5. Bright red line back of black patch on head.

Dryobates scalaris cactophilus Ober. Cactus Woodpecker. H.W. Several records for Mojave desert. Breeding near Victorville. W.M.P.

Dryobates nuttalli Gamb. Nuttall Woodpecker. Common in canyons up to 5000 feet; also in willow and sycamore groves in lowlands. Nesting, May, 1916, San Gabriel Canyon, Santa Ana river bottoms near Corona, San Antonio Canyon. W.M.P. Pl. V. Fig. 6. Bright red patch back of black patch on head.

Xenopicus albolarvatus gravirostris Grinn. San Bernardino White-headed Woodpecker. Found in the higher mountains of the San Gabriel range, Baldy, Ontario, etc., in summer. W.M.P. Pl. V. Fig. 7. Bright red patch on head.

Sphyrapicus varius daggetti Grinn. Sierra Red-breasted Sapsucker. H.W. Several winter records. W.M.P.. Pl. V. Fig. 8. Head and throat bright red, shaded into yellow on breast.

Melanerpes formicivorus bairdi Ridg. California Woodpecker. H.W., Metz. Nesting and resident. W.M.P. Pl. V. Fig. 9. Bright red patch on back of head, yellow tinge on throat.

Asyndesmus lewisi Riley. Lewis Woodpecker. Common Brown's Flats in spring. H.W. Casual migrant, noted years ago in Blanchard Park, Claremont, in small numbers in spring. W.M.P. Pl. V. Fig. 10. Red spot on front of head, breast streaked with red.

Colaptes cafer collaris Vigors. Red-shafted Flicker. H.W., Metz, H.H.T. Laguna. L.L.G. Abundant, especially fall and winter. Breeds San Antonio Canyon, Santa Ana river bottom. W.M.P. Pl. V. Fig. 11. Red streak on side of throat, under tail and red wing quills.

Phalaenoptilus nuttalli californicus Ridg. Dusky Poor-will. H.W. Fairly common at mouth of San Antonio and San Dimas Canyons in spring. Noted in upper Lytle Creek, Sept., 1915, and Glen Ranch, 1916. W.M.P. Pl. V. Fig. 12.

Chordeiles virginianus hesperis Grinn. Pacific Nighthawk. Found only in Big Bear Valley. Possibly occurs in our mountains. W.M.P. Pl. V. Fig. 13.

Chordeiles acutipennis texensis Law. Texas Nighthawk. H.W. Common about Claremont. W.M.P., Metz. Laguna. H.H.N.

Chaetura vauxi Towns. Vaux Swift. Noted in fall migration, Santa Ana river. W.M.P.

Aeronautes melanoleucus Baird. White-throated Swift. H.W. Capistrano. H.H.N. Noted in migration in fall, Santa Ana river bottoms. Taken along cliffs near Laguna. Spring. W.M.P. Pl. V. Fig. 14.

Archilochus alexandri Bou. and Mul. Black-chinned Hummingbird. H.W. Nestings San Antonio Canyon, near Corona, near Ontario. W.M.P.

Calypte costae Bour. Costa Hummingbird. H.W., Metz. Abundant in mountains and lower. W.M.P. Pl. V. Fig. 15. Throat purple.

Calypte anna Less. Anna Hummingbird. Metz, H.W. Common all year, nests in Claremont. W.M.P. Pl. V. Fig. 16. Red throat.

Selasphorus rufus Gmel. Rufous Hummingbird. H.W., Metz. Common migrant in spring. W.M.P. Pl. V. Fig. 17. Breast brownish, some red spots which are small. Back more brown than others.

Tyrannus verticalis Say. Western Kingbird. H.W. Laguna. L.L.G. Common and nesting, Chino, San Antonio Canyon. W.M.P. Pl. V. Fig. 18. Streak of red on center of head.

Tyrannus vociferans Swains. Cassin Kingbird. H.W. Laguna Gardner. Common migrant near Chino. No nesting records. W.M.P. Pl. V. Fig. 19. Red streak, center of head.

Myiarchus cinerascens cinerascens Law. Ash-throated Flycatcher. H.W. Claremont. Metz. Laguna. L.L.G. Common about Claremont in migrations. Breeding in some of the canyons. W.M.P. Pl. V. Fig. 20.

Sayornis sayus Bonap. Say Phoebe. H.W. Claremont. Metz. Laguna L.L.G. Common, fall and winter; possibly a few pairs breed. W.M.P. Pl. V. Fig. 25.

Sayornis nigricans Swain. Black Phoebe. H.W. Laguna Gardner. Common from ocean to mountains and into canyons. Many nesting records. W.M.P. Pl. V. Fig. 24.

Nuttallornis borealis Swains. Olive-sided Flycatcher. H.W. Claremont. Metz. Common in higher mountains. Found in valleys during migrations. W.M.P. Pl. V. Fig. 21.

Myiochanes richardsoni richardsoni Swains. Western Wood Pewee. H.W. Abundant and nests in canyons, in valley during migrations. W.M.P. Pl. V. Fig. 26.

Empidonax difficilis difficilis Baird. Western Flycatcher. H.W. Summer resident of canyons; many nesting records for Cucamonga, San Dimas, San Gabriel Canyons. W.M.P.

Empidonax trailli trailli Audub. Traill Flycatcher. H.W. Summer visitant to willow bottoms and in less numbers to canyons. W.M.P. Pl. V. Fig. 22.

Empidonax hammondi Xanthus. Hammond Flycatcher. One record San Dimas Canyon. W.M.P.

Pyrocephalus rubinus mexicanus Sclat. Vermilion Flycatcher. One record Santa Ana river bottom near Corona in winter. W.M.P.

Otocoris alpestris actia Oberh. California Horned Lark. H.W. Claremont. Metz. Laguna. L.L.G. Abundant, resident. W. M.P. Pl. V. Fig. 27.

Cyanocitta stelleri frontalis Ridg. Blue-fronted Jay. H.W. Common resident of mountains from 3,000 to 9,000 feet. One breeding date, May, 1915, San Gabriel Canyon. W.M.P. Pl. V. Fig. 28.

Aphelocoma californica californica Vig. California Jay. H.W. Claremont. Metz. Laguna. L.L.G. Abundant, Claremont and lower canyons. W.M.P. Pl. V. Fig. 29. Bright blue.

Corvus corax sinuatus Wag. Western Raven. Seen. H.W. Laguna. L.L.G., H.H.N. and W.M.P. Pl. V. Fig. 33.

Corvus brachyrhynchos hesperis Ridg. Western Crow. H.W. Very abundant on willow river bottoms, Corona, El Monte. Nest on Santa Ana. W.M.P. Also seen near south hills near Pomona. Pl. V. Fig. 32.

Nucifraga columbiana Wilson. Clarke Nutcracker. H.W. Noted on the high slopes of Mount San Antonio. W.M.P. Pl. V. Fig. 31.

Cyanocephalus cyanocephalus Wied. Pinyon Jay. Seen in flocks in spring of 1917 near Box S Ranch on Mojave Desert. Records for San Bernardino Range, not for San Gabriel. W.M.P. Pl. V. Fig. 30. Bluish grey.

Molothrus ater obscurus Gmel. Dwarf Cowbird. Eggs probably of this species found in Santa Ana river flats near Corona on several occasions. W.M.P.

Xanthocephalus xanthocephalus Bonap. Yellow-headed Blackbird. H. W. Collected during migration in spring near Chino, and nesting near Nigger slough. W.M.P. Pl. V. Fig. 34.

Agelaius phoeniceus neutralis Ridg. San Diego Red-winged Blackbird. H.W. Very abundant in lowlands about Chino. W.M.P. Pl. V. Fig. 35.

Agelaius tricolor Audub. Tri-colored Red-winged Blackbird. H.W. Several specimens taken near Corona, Chino, etc. W.M.P.

Sturnella neglecta Audub. Western Medowlark. H.W., Metz. Abundant in lowlands common about Claremont. W.M.P. Pl. V. Fig. 36. Canary yellow on throat, side and breast.

Icterus parisorum Bonap. Scott Oriole. H.W. Quite common on Mojave Desert. W.M.P. Pl. V. Fig. 38. Black and very deep yellow.

Icerus cucullatus nelsoni Ridg. Arizona Hooded Oriole. H.W. Claremont. Metz. Laguna. L.L.G. Locally common at Ontario, Claremont, Pomona, etc. Many nesting dates, usually nesting in palms. W.M.P. Pl. V. Fig. 37. Black and very deep yellow.

Icterus bullocki Swains. Bullock Oriole. H.W. Claremont. Metz. Abundant from ocean to 5,000 feet. Breeding at Hesperia. W.M.P. Pl. V. Fig. 39. Black and orange.

Euphagus cyanocephalus Wag. Brewer Blackbird. H.W., Metz. Especially abundant in Claremont. Many records. W.M.P.

Carpodacus purpureus californicus Baird. California Purple Finch. H.W. Winter visitant to Claremont, San Antonio Canyon. W.M.P. Pl. VI. Fig. 1. Head and throat a rich red.

Carpodacus cassini Baird. Cassin Purple Finch. H.W. Claremont. Metz. Winter migration record for Claremont, Pomona,

San Antonio Canyon. W.M.P. Pl. VI. Fig. 2. Top of head rich red, thorax and sides tinged with red.

Capodacus mexicanus frontalis Say. California Linnet. H.W. Claremont. Metz. Laguna. L.L.G. Abundant from ocean to mountains. Less common above 3,000 feet. Nests about buildings and in cactus. W.M.P. Pl. VI. Fig. 3. Head and throat rich red.

Astragalinus tristis salicamans Grinn. Willow Goldfinch. H.W. Claremont. Metz. Redlands, San Antonio Station; very abundant El Monte, Corona. Many nesting records in bottoms. W.M.P. Pl. VI. Fig. 4. Breast and neck canary yellow.

Astragalinus psaltria hesperophilus Ober. Green-backed Goldfinch. H.W. Claremont. Metz. Claremont, San Antonio Canyon, Corona, Laguna. Common. Breeding San Antonio Canyon. Claremont, near Covina. W.M.P. Pl. VI. Fig. 5. Breast canary yellow, back yellowish-green.

Astragalinus lawrencei Cass. Lawrence Goldfinch. H.W. Breeding in Claremont, San Antonio Canyon, near Corona. Found also in upper San Gabriel. W.M.P. Pl. VI. Fig. 6. Canary yellow breast, streaks on wings.

Spinus pinus pinus Wilson. Pine Siskin. Common winter visitant to San Antonio and other parts of mountains. W.M.P. Pl. VI. Fig. 7.

Passer domesticus Linn. English Sparrow. H.W. Noted at Claremont, Pomona, Ontario, San Bernardino, Victorville, Hesperia, El Monte, Box S. Ranch. W.M.P. Pl. VI. Fig. 8.

Pooecetes gramineus confinis Miller. Western Vesper Sparrow. H.W. Several records, fall and winter, Corona, Chino, near Etiwanda. W.M.P. Pl. VI. Fig. 9.

Pooecetes gramineus affinis Miller. Oregon Vesper Sparrow. Probably occurs. H.W.

Passerculus sandwichensis alaudinus Bonap. Western Savanna Sparrow. H.W. Abundant in lowlands, winter and fall. W.M.P. Pl. VI. Fig. 11.

Passerculus rostratus rostratus Cass. Found quite commonly near Oceanside. October 19, 1916. W.M.P.

Passerculus beldingi Ridg. Belding Marsh Sparrow. Common at Newport. One breeding record. W.M.P. Pl. VI. Fig. 12.

Ammodramus savannarum bimaculatus Swain. Western Grasshopper Sparrow. H.W. Records as follows: One male, near Corona, Calif.; one female, mouth of Lytle Creek Canyon, September 11, 1915; May 22, 1915, several Nigger Slough, near San Pedro. W.M.P. Pl. VI. Fig. 13.

Chondestes grammacus strigatus Swain. Western Lark Sparrow. H.W. Claremont. Metz. Laguna. L.L.G. Abundant near Corona, Chino, mouth of Lytle Creek Canyon; fairly common Mojave Desert. Claremont. W.M.P. Pl. VI. Fig. 17.

Zonotrichia leucophrys leucophrys Forst. White-crowned Sparrow. North of Claremont. In college collection. H.W. Two records, near Claremont. Specimen from desert in spring. W.M.P. Pl. VI. Fig. 18.

Zonotrichia leucophrys gambeli Nutt. Intermediate Sparrow. H.W. Very abundant ocean to foothills, fall and winter. Recorded late in April from Claremont. W.M.P. Pl. VI. Fig. 19.

Zonotrichia coronata Pall. Golden-crowned Sparrow. H.W. Winter, San Dimas, upper San Antonio, along foothills. W.M.P. Pl. VI. Fig. 15.

Spizella passerina arizonae Coues. Western Chipping Sparrow. H.W. Claremont. Metz. Breeding records, Claremont. W.M.P.

Spizella breweri Cass. Brewer Sparrow. Migration records in spring, Claremont. W.M.P. Pl. VI. Fig. 16.

Spizella atrogularis Caban. Black-chinned Sparrow. Seen. H.W. Migration records in spring. W.M.P. Pl. VI. Fig. 10.

Junco oreganus thurberi Anthony. Sierra Junco. H.W., Metz. Common; breeds in mountains, in valleys in spring. W.M.P. Pl. VI. Fig. 14.

Amphispiza bilineata deserticola Ridg. Desert Black-throated Sparrow. H.W. One record for Claremont. Specimen in Pomona College collection. Abundant, breeding in desert near Victorville, spring 1917. W.M.P. Pl. VI. Fig. 20.

Amphispiza belli Cass. Bell Sparrow. H.W. Claremont. Metz. Common, breeding near Claremont. Found up to San Antonio Canyon. W.M.P. Pl. VI. Fig. 21.

Amphispiza nevadensis canescens Grinn. California Sage Sparrow. H.W. Fall; common at Glenn Ranch. W.M.P. Pl. VI. Fig. 22.

Aimophila ruficeps ruficeps Cass. Rufous-crowned Sparrow. H.W. Laguna. L.L.G. Resident foothills near Claremont, mouth of San Antonio Canyon. W.M.P. Pl. VI. Fig. 23.

Melospiza melodia cooperi Ridg. San Diego Song Sparrow. H. W. Claremont. Metz. Laguna. L.L.G. Very abundant in river bottoms; many breeding records; Claremont to coast. W.M.P. Pl. VI. Fig. 27.

Melospiza lincolni lincolni Aud. Lincoln Sparrow. H.W. Winter resident to our valleys. W.M.P. Pl. VI. Fig. 24.

Certain of the fox sparrows are very hard to place. The notes that I give are only provisional and further study of this group may place these under different sub-species. Then there are many intergrades that are difficult to correctly place. The sub-species that are hard to differentiate are as follows:

Passerella ilica unalascheensis Gmel. Shumagin Fox Sparrow. Taken in winter, San Antonio Canyon.

P. i insularis Rid. Kadiak Fox Sparrow. Winter, San Antonio Canyon.

P. i sinuosa Grinn. Valdez Fox Sparrow. San Dimas Canyon in winter.

P. i meruloides Vig. Yakutat Fox Sparrow. Several San Antonio Canyon in winter.

P. i altivagans Rid. Alberta Fox Sparrow. Several in winter, San Dimas Canyon. W. M. P.

Passerella iliaca schistacea Baird. Slate-colored Fox Sparrow. Taken in winter, San Dimas Canyon; Lytle Creek in fall. W.M.P.

Passerella iliaca megarhyncha Baird. Thick-billed Fox Sparrow. Recorded in winter, San Antonio Canyon, San Dimas Canyon. W. M. P.

Passerella iliaca stephensi Anth. Stephens Fox Sparrow. H.W. No valley records. W.M.P. Pl. VI. Fig. 26.

Pipilo maculatus megalonyx Baird. Spurred Towhee. H.W. Claremont. Metz. Abundant, breeding in Claremont, Corona, San Antonio Canyon, Laguna. W.M.P. Pl. VI. Fig. 28.

Pipilo crissalis senicula Anth. Anthony Brown Towhee. H.W. Claremont. Metz. Abundant, breeding Claremont to Laguna. W.M.P. Pl. VI. Fig. 30.

Oreospiza chlorura Audub. Green-tailed Towhee. H.W. Breeds on high mountains (about 8,000 feet), Lytle Creek, near Corona in winter. W.M.P. Pl. VI. Fig. 29.

Zamelodia melanocephala capitalis Baird. Pacific Black-headed Grosbeak. Metz. Claremont. H.W. Breeding at Claremont, near Corona. W.M.P. Pl. VI. Fig. 31. Female.

Guiraca caerulea salicarius Grinn. California Blue Grosbeak. H. W. Laguna. H.H.N. Santa Ana river bottom in spring; Brea Canyon. W.M.P. Pl. VI. Fig. 32. Dark blue, rufous on wings.

Passerina amoena Say. Lazuli Bunting. H.W. Claremont. Metz. Fairly common in Claremont, seen in Brea Canyon and near Chino, San Antonio Canyon, San Dimas Canyon. W.M.P. Pl. VI. Fig. 33. Bright blue touched with rufous.

Calamospiza melanocorys Stejn. Lark Bunting. One record near Corona, May 11, 1915. W. M. P.

Piranga ludoviciana Wilson. Western Tanager. H.W. Common in canyons in summer, upper San Antonio, Cucamonga; breeding records; spring migration records for Claremont. W.M.P. Pl. VI. Fig. 34. Head brilliant red shaded over yellow.

Progne subis hesperia Brew. Western Martin. Two specimens in college collection, taken 1896. Pl. VI. Fig. 35. Female.

Petrochelidon lunifrons lunifrons Say. Cliff Swallow. H.W. Long Beach. Metz. Laguna Beach Gardner. Breeding. Very abundant from mouth of San Antonio to ocean; nests on barns, houses, etc.; cliffs near Laguna. W.M.P. Pl. VI. Fig. 36.

Hirundo erythrogaster Bodd. Barn Swallow. Seen. H.W. Migration records for Chino, Corona, Laguna. W.M.P. Pl. VI. Fig. 38.

Iridoprocne bicolor Vieil. Tree Swallow. H.W. Breeds near Corona; seen in winter in same locality less commonly. W.M.P. Pl. VI. Fig. 39.

Tachycineta thalassina lepida Mearns. Northern Violet-green Swallow. H.W. Claremont. Metz. Breeds in San Antonio Canyon.

Riparia riparia Linn. Bank Swallow. Nesting record for Newport, June, 1916. Migration record near Corona in spring. W.M.P. Pl. VI. Fig. 37.

Stelgidopteryx serripennis. Audub. Rough-winged Swallow. Pl. VI. Fig. 40.

Bombycilla cedrorum Vieill. Cedar Waxwing. H.W. Claremont. L.L.G. Very abundant in fall, winter and spring, Claremont, Ontario, Pomona, San Antonio, San Dimas. W.M.P. Pl. VII. Fig. 1.

Phainopepla nitens Swain. Phainopepla. H.W. Claremont. Metz. Breeding records Claremont; winters regularly near Corona in river bottoms. Some winters seen in Claremont. W.M.P. Pl. VII. Fig. 2.

Lanius ludovicianus gambeli Ridg. California Shrike. H.W. Laguna. L.L.G. Resident. Breeds Corona, Chino, Ontario; common at Claremont. W.M.P. Pl. VII. Fig. 3.

Vireosylva gilva swainsoni Baird. Western Warbling Vireo. H.W. Abundant in summer in canyons. Breeds. W.M.P. Pl. VII. Fig. 4.

Lanivireo solitarius cassini Xant. Cassin Vireo. H.W. San Antonio, Glenn Ranch. W.M.P. Pl. VII. Fig. 6.

Vireo huttoni huttoni Cass. Hutton Vireo. H.W. Claremont, San Antonio Canyon. Nests. Resident. W.M.P. Pl. VII. Fig. 5.

Vireo belli pusillus Coues. California Least Vireo. H.W. Laguna. L.L.G. Fairly common Glenn Ranch and near Corona. Breeding notes. W.M.P.

Vireo vicinior Coues. Gray Vireo. Capistrano. H.H.N. Several seen in Cajon Pass, elevation 3,700 feet. W.M.P.

Vermivora ruficapilla gutturalis Ridg. Calaveras Warbler. H.W. Migrates. Glenn Ranch, San Gabriel Canyon. W.M.P.

Vermivora celata lutescens Ridg. Lutescent Warbler. H.W. Glenn Ranch, San Gabriel Canyon, San Antonio and San Dimas Canyons. W.M.P. Pl. VII. Fig. 7. Canary yellow.

Vermivora celata sordida Towns. Dusky Warbler. San Dimas Canyon. Winter. W. M. P.

Dendroica aestiva brewsteri Grinn. California Yellow Warbler. H.W., Metz. Claremont. Breeding near Corona river bottoms. Pl. VII. Fig. 8. Canary-yellow.

Dendroica auduboni auduboni Towns. Audubon Warbler. H.W. Claremont. Metz. Abundant in winter in San Antonio Canyon, Claremont, Pomona, Corona. Breeds in higher mountains. W.M.P.

Pl. VII. Fig. 10. Five yellow spots, top of head, throat, under wings, on rump.

Dendroica nigrescens Towns. Black-throated Gray Warbler. Seen. H.W. Breeds near Camp Baldy and Cold Brook, San Gabriel Canyon. W.M.P. Claremont during migration. Pl. VII. Fig. 9. Small yellow spot in front of eye.

Dendroica occidentalis Towns. Hermit Warbler. H. W. Seen. Migration near Corona, Santa Ana river bottom, upper Lytle Creek. W.M.P. Pl. VII. Fig. 11. Bright yellow on side and top of head.

Oporornis tolmiei Towns. Tolmie Warbler. Migration notes from Cold Brook, Glenn Ranch, Claremont, upper Lytle Creek. W.M.P.

Geothlypis trichas occidentalis Brew. Western Yellowthroat. H.W. Taken in migration at Claremont. Breeds on river bottoms near Corona, Chino and El Monte. W.M.P. Pl. VII. Fig. 12. Bright yellow throat, back greenish grey.

Icteria virens longicauda Lawr. Long-tailed Chat. H.W. Breeds near Corona. W.M.P. Pl. VII. Fig. 13. Bright yellow throat.

Wilsonia pusilla chryseola Ridg. Golden Pileolated Warbler. H.W. Migration near Claremont. One breeding record. Santa Ana river bottoms. W.M.P. Pl. VII. Fig. 14. Canary-yellow throat. Back greenish-grey.

Wilsonia pusilla pileolata Pall. Alaska Pileolated Warbler. Capistrano. H.H.N.

Anthus rubescens Tunst. American Pipit. H.W. Long Beach. Metz. Abundant fall and winter, Corona, Chino, Ontario W.M.P. Pl. VII. Fig. 15.

Cinclus mexicanus unicolor Bonap. American Dipper. H. W. Resident San Antonio, San Dimas, Cucamonga, Lytle Creek. W.M.P. Pl. VII. Fig. 16. Female.

Oreoscoptes montanus Towns. Sage Thrasher. Taken fall and winter in Corona, near Etiwanda. Seen in early May, upper Cajon Pass. W.M.P. Pl. VII. Fig. 17.

Mimus Polyglottos leucopterus Vigors. Western Mockingbird. H.W. Claremont. Metz. Laguna. L.L.G. Breeds in Claremont. W.M.P. Pl. VII. Fig. 18.

Toxostoma redivivum pasadenense Grinn. Pasadena Thresher. H.W. Claremont. Metz. Laguna. L.L.G. Breeds at Claremont. W.M.P. Pl. VII. Fig. 19.

Toxostoma lecontei lecontei Law. Leconte Thrasher. Seen on Mojave Desert. H.W. Resident, breeding, limited numbers, Mojave Desert. W.M.P.

Heleodytes brunneicapillus couesi Sharpe. Northern Cactus Wren. H.W. Claremont. Metz. Common resident, breeding. W.M.P. Pl. VII. Fig. 21.

Salpinctes obsoletus obsoletus Say. Rock Wren. H.W. Many records, Claremont, San Antonio Canyon; higher mountains in summer. W.M.P. Pl. VII. Fig. 23.

Catherpes mexicanus punctulatus Ridg. Dotted Canyon Wren. H. W. Laguna. L.L.G. Nesting at San Gabriel, Cucamonga. Fairly common. W.M.P. Pl. VII. Fig. 22.

Thryomanes bewicki charienturus Oberh. San Diego Wren. H. W. Claremont. Metz. Breeding at Claremont, San Antonio, San Dimas Canyons. W.M. P. Pl. VII. Fig. 20.

Troglodytes aedon parkmani Audub. Western House Wren. H.W. Breeding up as far as Camp Baldy. W.M.P. Pl. VII. Fig. 25.

Telmatodytes palustris paludicola Baird. Tule Wren. H. W. Abundant and breeding in Santa Ana river bottom. W.M.P. Pl. VII. Fig. 24.

Nannus hiemalis pacificus Baird. Western Winter Wren. One record, San Dimas Canyon, Jan. 21, 1915. W.M.P.

Certhia familiaris zelotes Osg. Sierra Creeper. Lytle Creek. Glenn Ranch. W.M.P. Pl. VII. Fig. 26.

Sitta carolinensis aculeata Cass. Slender-billed Nuthatch. Seen. H.W. Recorded upper Lytle Creek, Glenn Ranch. W.M.P. Pl. VII. Fig. 27.

Sitta pygmaea pygmaea Vigors. Pigmy Nuthatch. Upper Lytle Creek. W.M.P. Pl. VII. Fig. 28.

Baeolophus inornatus inornatus Gamb. Plain Titmouse. H.W. Oaks near Claremont. W.M.P. Pl. VII. Fig. 29.

Penthestes gambeli baileyae Grinn. Baily Chickadee. H.W. Common higher mountains. Sometimes occurs in winter in valleys. Recorded several times from foothills near San Antonio and San Dimas Canyons. Pl. VII. Fig. 34.

Psaltriparus minimus minimus Ridg. Coast Bush-tit. H.W. Claremont. Metz. Common, breeding at San Dimas, San Antonio, Claremont. Pl. VII. Fig. 30. May be A.O.U. 743A. W.M.P.

Chamaea fasciata henshawi Ridg. Pallid Wren-tit. H.W. Laguna L.L.G. Abundant and breeding Claremont to Laguna, also up in mountains some distance. W.M.P. Pl. VII. Fig. 35.

Regulus satrapa olivaceus Baird. Western Golden-crowned Kinglet. Recorded in winter, San Antonio Canyon. W.M.P.

Regulus calendula cineraceus Grinn. Western Ruby-crowned Kinglet. H.W. Claremont. Metz. Recorded in winter, San Antonio, San Dimas Canyon, Corona. W.M.P. Pl. VII. Fig. 33. Bright red line on top of head.

Polioptila caerulea obscura Ridg. Western Gnatcatcher. H.W. Claremont. Metz. Common and breeding San Antonio Canyon, San Dimas, San Gabriel Canyon, Claremont. W.M.P. Pl. VII. Fig. 32.

Polioptila californica Brew. Black-tailed Gnatcatcher. H.W. Claremont. Metz. Many breeding records. Claremont. W.M.P. Pl. VII. Fig. 31.

Myadestes townsendi Audub. Townsend Solitaire. H.W. Taken in winter. Fairly common in San Antonio Canyon and San Dimas Canyon. Seen in Claremont in winter. W.M.P. Pl. VII. Fig. 36.

Hylocichla guttata nanus Audub. Dwarf Hermit Thrush. H.W. Breeds near Corona, Glenn Ranch. W.M.P. Pl. VII. Fig. 37.

Hylocichla guttata nanus Audub. Dwarf Hermit Thrush. H.W. One bird taken in winter near Claremont which Grinnell thinks is this. W.M.P.

Hylocichla guttata guttata Pall. Alaska Hermit Thrush. H.W. San Dimas Canyon, Claremont. W.M.P.

Hylocichla guttata sequoiensis Baldy. H.W. Sierra Hermit Thursh. Lytle Creek. W.M.P

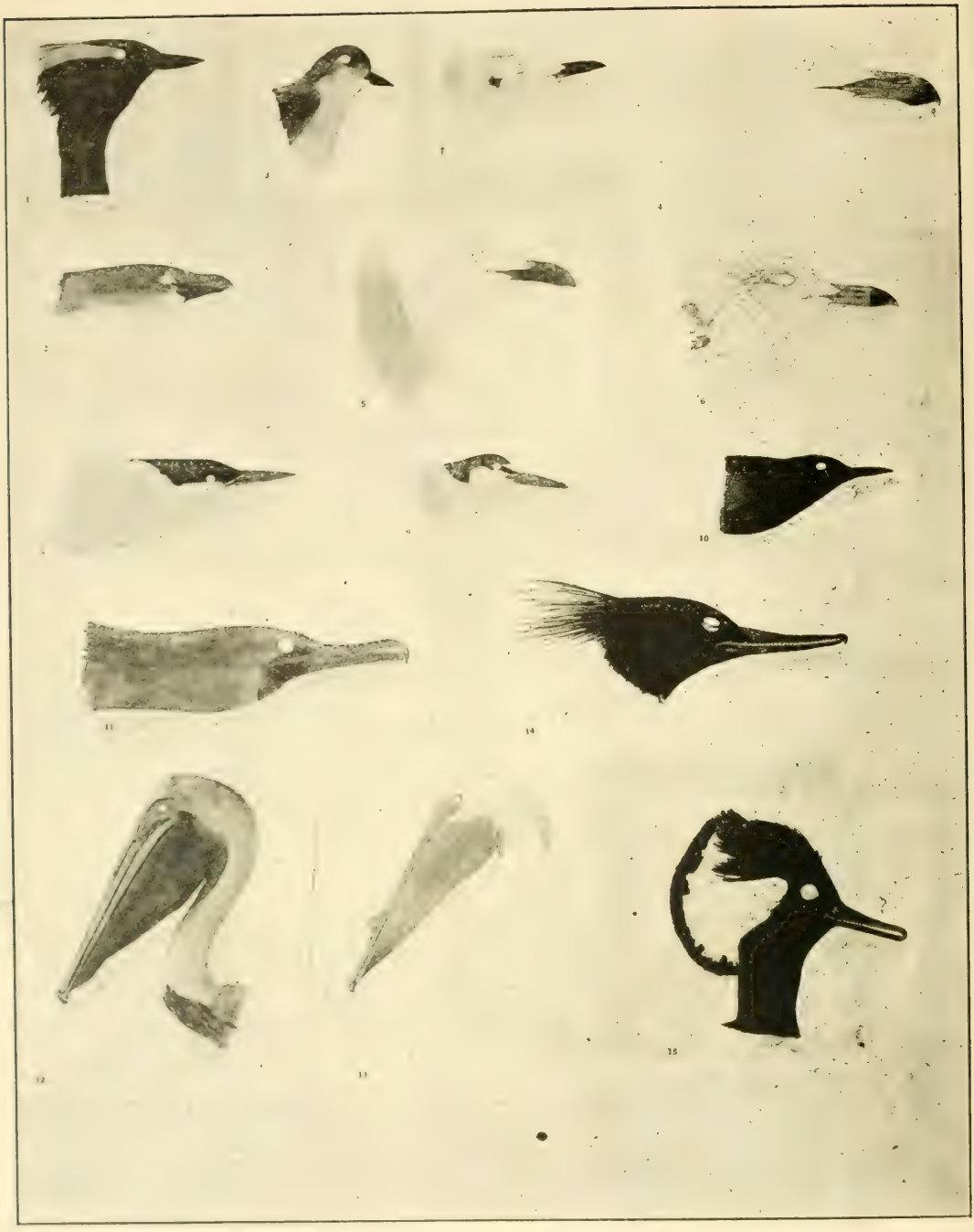
Planesticus migratorius propinquus Ridg. Western Robin. H.W. Common in winter, Claremont. W.M.P. Pl. VII. Fig. 38.

Ixoreus naevius meruloides Gmel. Varied Thrush. H.W. Winter records, San Dimas Canyon and Claremont. W.M.P. Pl. VII. Fig. 39.

Sialia mexicana occidentalis Towns. Western Bluebird. H. W. Claremont. Metz. Breeding record, San Dimas Canyon. Common in winter in valley. Breeds in higher mountains. W.M.P. Pl. VII. Fig. 40. Purple-blue, rufus on wings.

Sialia currucoides Bechst. Mountain Bluebird. H.W. Many records for winter, Etiwanda, Corona, Chino, Pomona. W.M.P. Pl. VII. Fig. 41. Light blue, greenish blue on throat.

(Contribution from the Zoological Laboratory of Pomona College)



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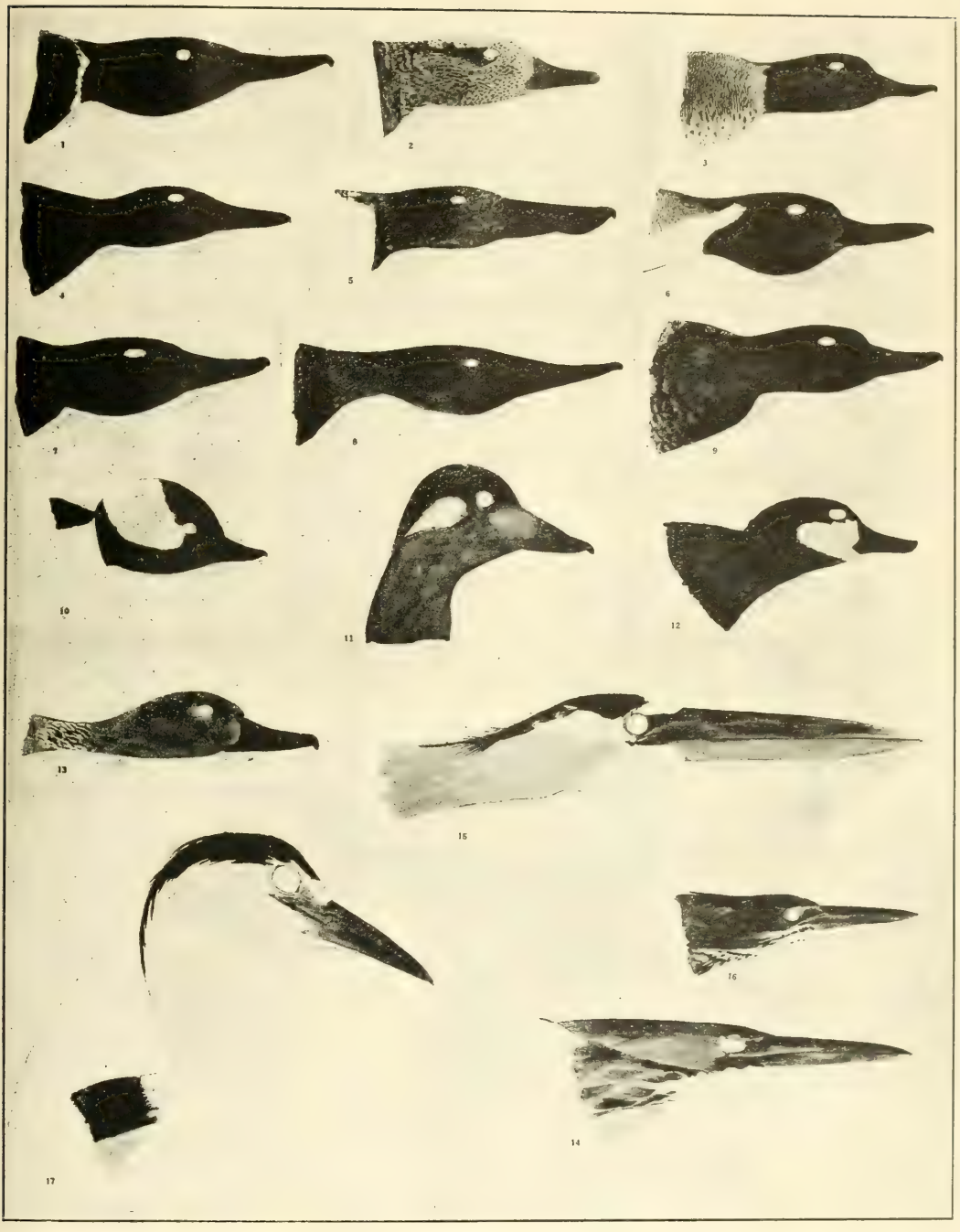

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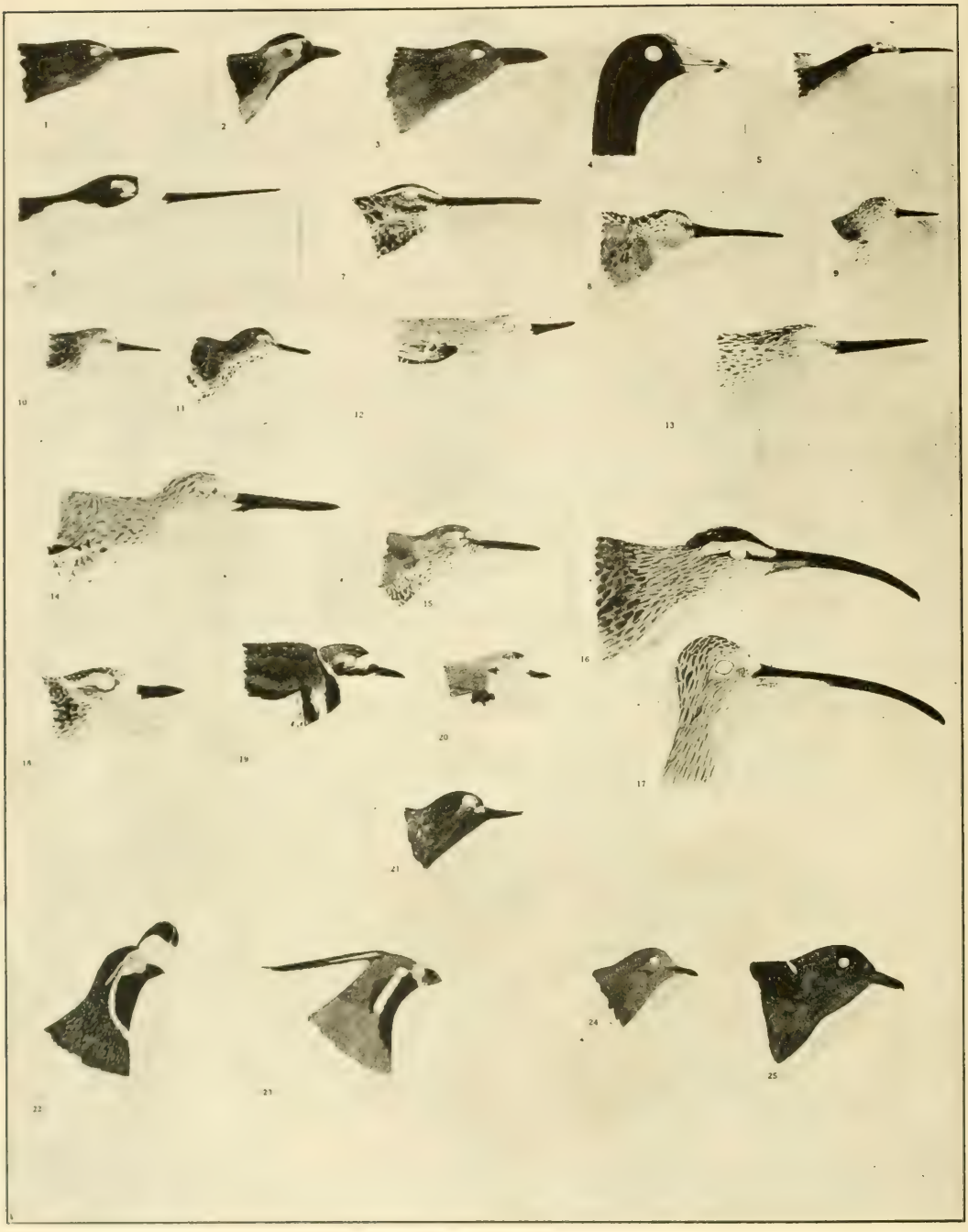

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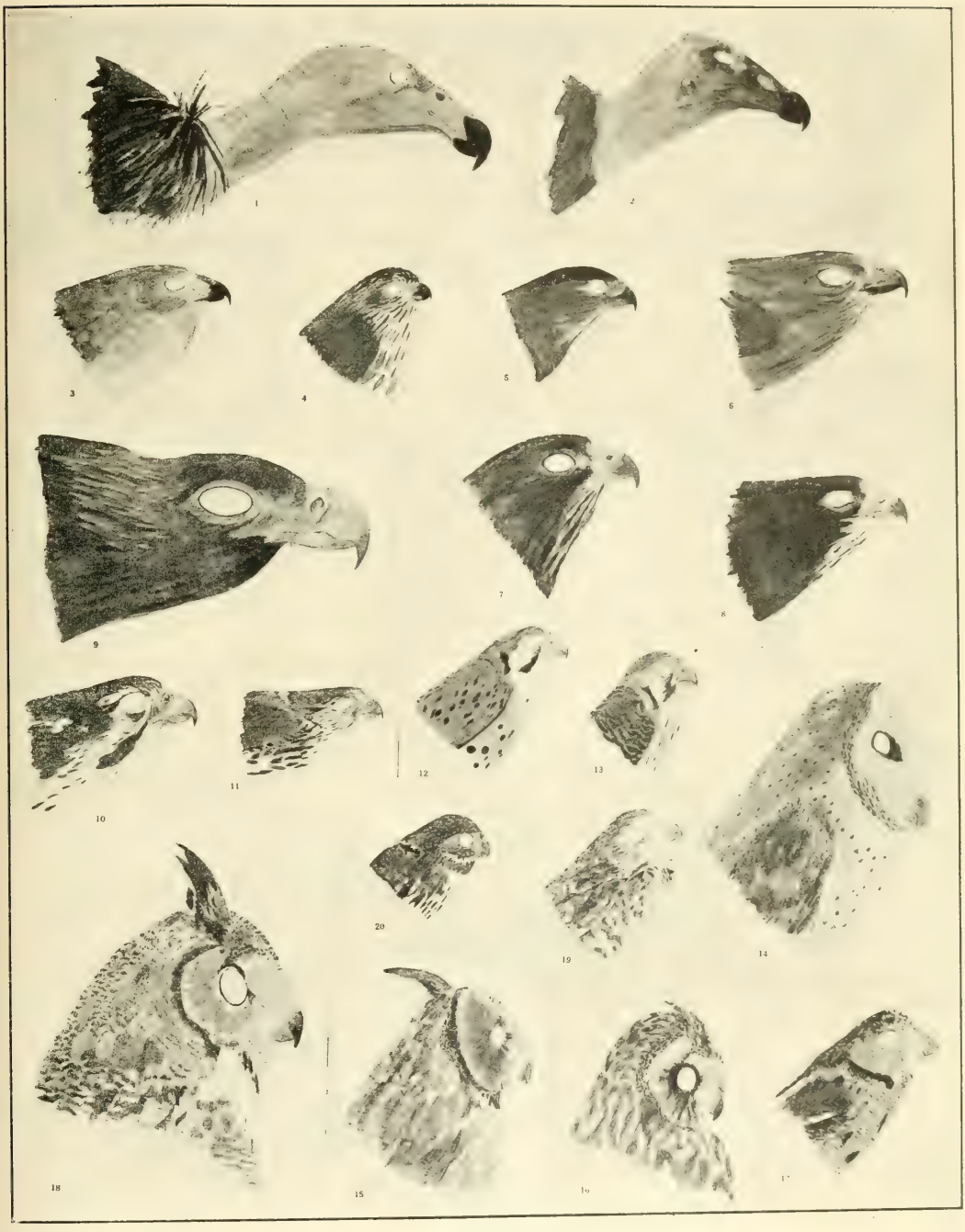

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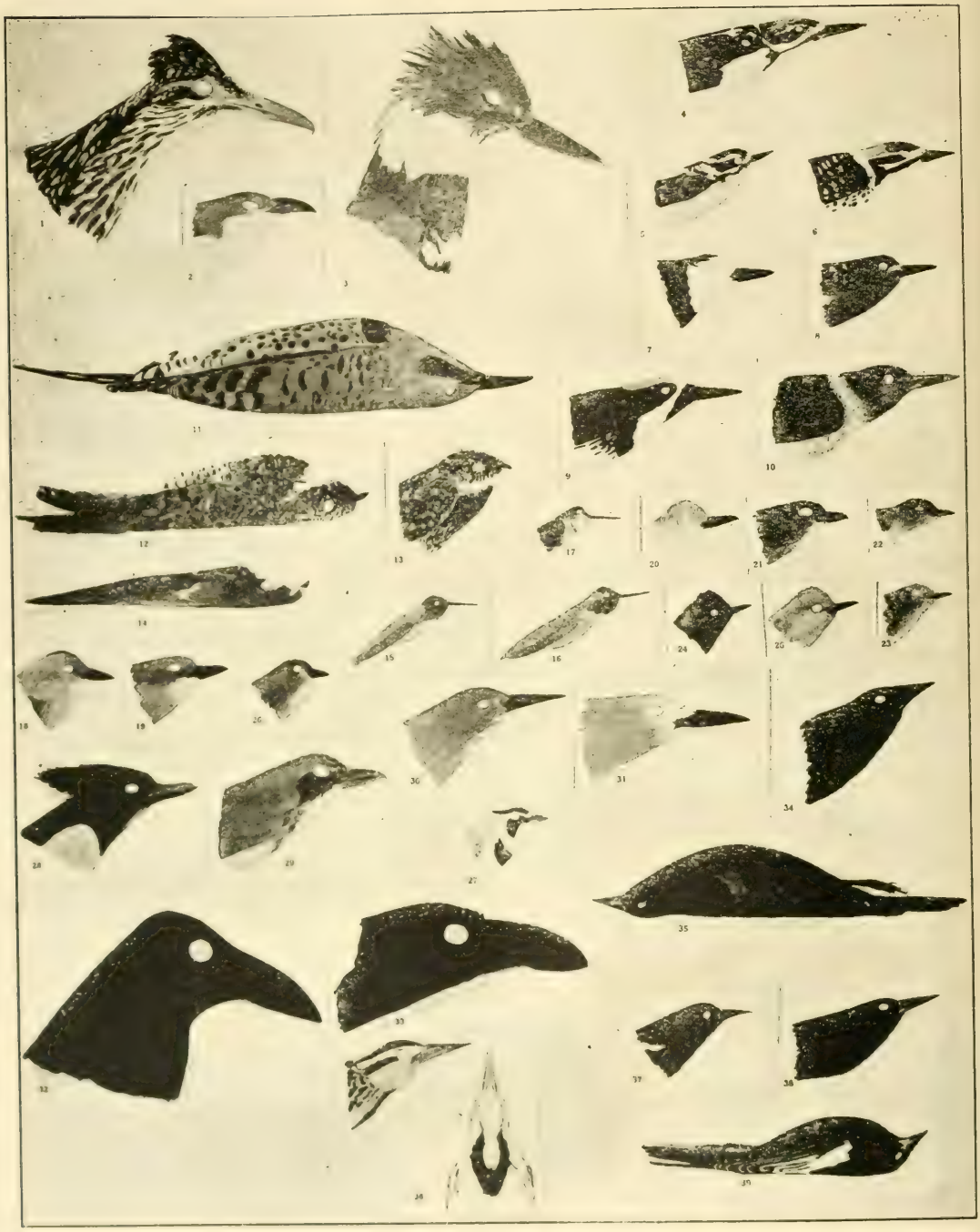

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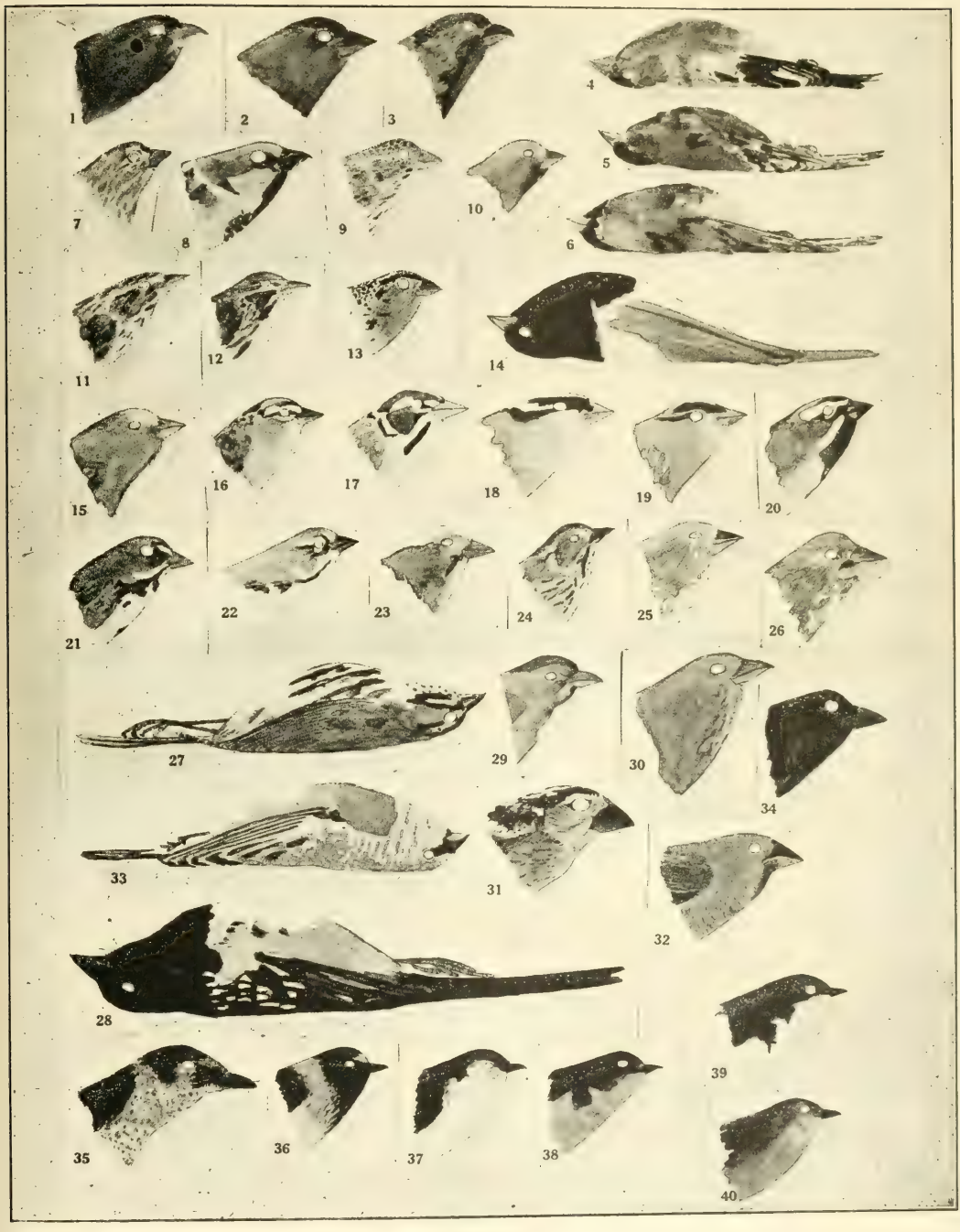
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Plate VI

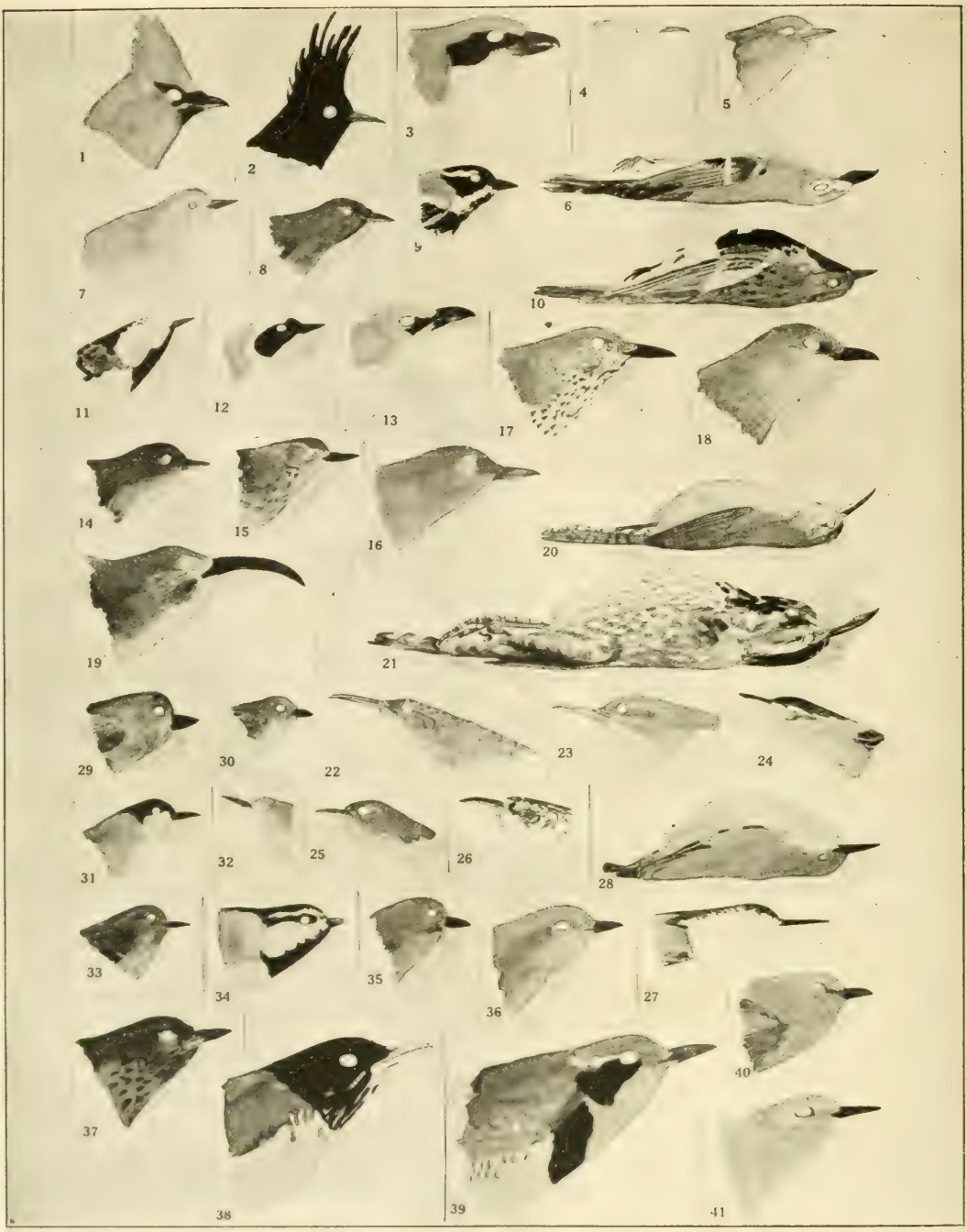
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Plate VII

The Nervous System of Aracoda Semimaculata and the Description of a Method of Stereographic Reconstruction

WILLIAM F. HAMILTON

Aracoda semimaculata, of the family Lumbriconereidæ (polychætous annelids) is found in great abundance in the mussel beds near Laguna Marine Laboratory. In length the worm may be from five to fifty cm. and in diameter, from two to six mm. In general appearance these worms resemble the earth worm, being without palpi, or tentacles and usually of a reddish brown color. Pigmentation, however, varies from a deep reddish brown to a pale yellow. The cuticle is a tough chitinous membrane clear yellow in cross section, but due to the fact that it is laid on in exceedingly thin laminæ it presents a beautifully iridescent surface.

The prostomium (Fig. 1), is a blunt, ovoid and slightly depressed organ which is practically made up of nervous and sensory tissue, constructed and inter-related in a very complex manner. The peristomium is about as long as the prostomium and twice as long as the body segments (Fig. 3). The body segments are unianulate and very distinct. The parapodia (Fig. 3; a), are biramous, the neuropodium, typically—in the middle segments of the worm—being distinctly longer than the notopodium and bent up finger-like at the tip. The notopodium appears as a broadly rounded discontinuation of the upper half of the body of the parapodium. It is equipped with a varying number of winged pointed setæ and blunt uncinate setæ. The front and hind parapodia become less and less typical as the ends of the worm are approached.

METHODS

Fixation. A large number of the worms, fixed in acetic sublimate and in hot mercuric chlorid were prepared during the summer at the Laguna Marine Laboratory, transferred to 80 per cent alcohol and saved for study the following winter in Claremont. Those fixed in the acetic mixture could easly be sectioned whole in

paraffin of a melting point of 60-62 degrees, but it was necessary to peel off the cuticle and withdraw the setæ of those fixed in hot mercuric chlorid. The internal connective tissues, however, were better preserved in this fluid. There seemed to be no marked difference in fixation of the other tissues.

Staining. The most effective stain for tracing out gross anatomy and nerve distribution proved to be a faintly acidified borax carmine used after a fixation of hot mercuric chlorid. The muscular and epithelial tissues were stained a uniform light pink, the nervous tissues a darker pink and the connective tissues, especially the perineurium a bright red. Villain's copper hematoxylin, iron hematoxylin, and double stains of these and methylin blue with eosin, "licht grün" and neutral red were of value for cellular detail.

Reconstruction Method. A wax and blotting paper model of the brain (Fig. 2), was made in the usual way. To supplement this two stereographic reconstructions (Figs. 1, 4) were made which were of advantage over the wax model in the following ways. They are easier to make, eliminating the steps that involve cutting out, impregnating and reassembling the parts of the wax reconstruction. It is possible as was done in Fig. 1 to make a "sciagraphic reconstruction" that will show the internal parts in their normal relation to the other organs. If necessary, colors could be used to make the morphological differentiation clearer. When the reconstruction is finished it is the reproduction at a certain magnification of any desired aspect of the object and is equal in all important respects and superior in many respects to a photograph or drawing of a wax reconstruction. What little distortion there is may be calculated as a function of the displacement angle and easily taken into account.

The method pursued may be described as follows: The object should be embedded with a piece of liver or similar tissue having a smooth and quite rectangular face parallel to the axis of the specimen. The pieces may be arranged on a watch crystal after infiltration and the embedding paraffin poured on hot enough not to form a crystallization capsule around them. This gives an orientation guide whose projection is represented in b (Fig. 14). Fig. 14 is a

diagramatic illustration of the reconstruction of one cylinder inside another by means of this method.

The sections are cut at right angles to the orientation plane and hence transversely to the axis of the object. The knife must be sharp and care must be taken in the mounting to prevent any warping or wrinkling of the sections. An outline of the first section is drawn by means of a projection lantern—represented by the shaded circles (Fig. 14; a)—and a line drawn on the projection of the edge of the section of the liver-piece, represented by the first cross line on b (Fig. 14). From the ends of this cross line are drawn lines in that direction from the cross line that is related to the cross line in the same way as the side of the drawing, which is a projection of part of the aspect to be reconstructed, is related to the center of the drawing. These two lines (the long parallel lines, Fig. 14; b), determine the projection of the orientation plane, and on them are measured off segments about equal to half of the product of the thickness of the sections times the magnification in diameters. The projection of the second section of the series is so placed that the projection of the edge of the liver section coincides with a line drawn between the dots marking off the first segment on the lines determining the orientation plane. The section itself is outlined in the same way except that those parts of the second outline which are "covered up" or are within the area bounded by the first outline are left blank, since they represent the parts of the surface which are hidden from view by the outcurving nearer surfaces. The process is repeated progressively along the segments of the displacement lines with all of the rest of the sections. Those lines which form the edges of the completed figure are re-enforced and then transferred to a separate sheet of paper. This bare outline is shaded to fill out the contour of which the lines on the other sheet are a topographic diagram as shown (Fig. 14c).

It is obvious that the cylinder is somewhat distorted since the face of the figure seen from this point of view should be an ellipse The distortion is known as a sheering distortion, but as it is constant and does not appreciably alter the relations of the parts the distorted reconstruction is quite as useful as the normal one.

The distortion may be eliminated in either of two ways. The first and best is to set the orientation guide at an agle of about 45 degrees from the axis of the object and cut the sections at right angles to the orientation guide and hence obliquely to the specimen. The reconstruction lines are drawn in the same way except that the projection of the orientation line is allowed to fall in the same place each time, thus eliminating the displacement and consequent distortion. It is hard, however, to get a clear idea of the relations of parts from oblique sections. The reconstruction does not show any more than one that follows the first method, and each series is good for reconstructing only one aspect.

The other way of getting rid of the distortion is to insert at the place of proper magnification in the cone of light rays from the projector a lense of sufficient curvature to refract the rays into a parallel bundle. By tilting the drawing board at a proper angle to this bundle the field will be caused to fall in such an ellipse as to eliminate any distortion. This angle is one whose tangent equals the displacement divided by the product of the thickness of the section times the magnification in diameters.

Occasionally wrinkling of the section in cutting or in mounting occurs and renders it necessary to disregard the orientation guide. It is easy, however to put the section in approximately its right place and to check it up by the next section. In reconstructing symmetrical specimens where there is a clearly marked axial line it is often possible to dispense with the orientation guide and to place the successive sections from landmarks which they themselves bear.

ANATOMY

The brain (Fig. 1, 2, 4) is a very complex structure. Topographically it is divided into two parts, the dorsal and ventral by the central mass of muscle and blood vessels (Figs. 5, 6, 7; q), which tissue, going forward from between the central part of the brain and the visceral ganglion, pinches out into a muscular sheet at either side and separates the six dorsal lobes from the eight to ten ventral lobes or branches of the fore part of the brain. The brain is symmetrical and is divided into lateral halves by a septum which continues as a canal through the main brain (Fig. 6; w).

Along slightly different lines the brain may be divided into sensory, cross-connective visceral and nuchal parts.

Sensory System. The prostomial system of sense organs in this form is one of the most complex and highly specialized among annelids. Just forward of the central cross-connective part (Fig. 6) the brain divides into two lateral halves, which extend down and connect with the two front branches of the visceral ganglion. These halves (Fig. 7), give off two rounded lateral sensory lobes (Figs. 1, 4, 6; b) and then divide into quadrants, the larger of which compose the lower pair. Each of these lower quadrants subdivides into four and sometimes five lobes (Figs. 1, 4, 5; c). The inner three are long and slender, while the outer one, which shows a tendency in large specimens to subdivide at the tip is much shorter and broader. The dorsal pair of quadrants each divide into three distinctly longer and more slender lobes, giving in all from fourteen to sixteen lobes. The lobes are each composed of a cellular and a fibrilar tract. The fiber bundle is on the inside and runs directly back to the main brain, while the cellular area is on the surface side of each lobe and is directly connected with the subcuticular sense organs. These cells (Fig. 12; u), underlie the whole of the prostomial cuticle and are connected with the brain by means of fibers which run into the brain in larger or smaller irregularly placed bundles or even as individual fibers, threaded between the epithelial cells of the subcuticular region. The whole of the prostomial nervous system, including the visceral ganglion and its branches give off sensory fibers in great abundance. In many cases the sense cells seem to send off sensory fibers direct to the cuticle.

In the front lobular region, besides the sense cells and the ordinary small nerve cells (Figs. 5, 6, 7, 10; d), there are a few large cells embedded in the brain (Figs. 5, 10; f). These have nucleoli and in some cases fibers can be traced from them. They are much smaller than the giant cells (Figs. 11, 8; g) in the ventral nerve cord, more irregular, the structure of the protoplasm is much finer and they are much harder to stain with ordinary stains. Hematoxylin leaves them clear unless a mordant is used. Methylen blue and the other common nuclear stains do not touch them. Villain's copper hematoxylin gives the best results, staining the protoplasm

reddish purple and the nucleus blue-black. These cells are found only in the front part of the prostomium. Associated with these in location are a number of mucous cells which have invaded the brain and from their staining reactions seem to be functional (Figs. 5, 10; h).

Cross-connective part of the brain. The main part of the brain contains the fibrilar cross-connections for the whole brain. The brain cells are practically all confined to the dorsal side. The eyes, four in number, are buried in this cell layer. The central pair is very small and vestigial, none of the lense structure remaining and but little of the pigment. The lateral pair is complete, with lense and cup-shaped pigment layer, but in all of the specimens I have sectioned the eye is inverted, with the pigment outside and the lense facing down toward the brain. As if to render this ocular paradox more striking the perfect eyes are deeply embedded in the head and the degenerate eyes are just under the cuticle. This is a rather interesting example of degeneration.

From the rear of the brain extend the circumœsophageal commissure and the nuchal ganglia. The former is biramous, dividing on each side into a dorsal and ventral branch. This is analagous to the phenomenon found in Nepthys where the ocular and surface-sensory parts of the brain are separate structures. (Quatrefages; 44.)

The nuchal ganglia (Figs. 13, 1, 4; i), are connected to the brain by means of two nerves .3 mm. apart, .03 mm. in diameter and 4 mm. long. These nerves come out from the "punkt-substanz" of the brain immediately below and behind the central pair of eyes, follow along the nuchal pits for some distance, when they join on the two nuchal ganglia on their lower front surface. The nuchal pits act as a pair of narrow-mouthed sacks opening, close together just under the lip of the peristomium, enlarging as they go in until they are large enough to contain in their thin chitino-membranous sack, each, a ganglion. The apparatus bears a rather vague resemblance to the otocyst found in Arenicola (Ehlers, '92), but inasmuch as there are no otolyths to be found and the only cavity to contain them is very small and pyramidal instead of round, the diagnosis is doubtful. The thing could hardly be functional, but is probably

degenerate or else for some other purpose. The ganglia are connected by their perineurial sheaths in the mid line and the nuchal sacks, though they do not fuse are separated merely by a thin septum. They differ in this respect from *Lumbriconereis erecta* Moore where the ganglia are quite widely separate. Histologically the structure is much the same as the other ganglia of this form. The cells are a little larger than those of the brain and the reticulum is considerably more noticeable.

The subœsophageal ganglion (Fig. 1; j) is of the usual annelid form as is the nerve trunk (Figs. 8, 9). The segmental nerves are given off one pair to each segment from a long narrow pedicle (Fig. 3; k). They follow around the segment just outside the muscular coat. At the base of the foot there is a small ganglion giving off two branches, one to the foot, which branches twice and one passing beyond the foot to the dorsum where it branches extensively in both the epithelium and muscles.

Visceral System. The visceral nervous system (Fig. 4), consists of three visceral ganglia, and a complex system of nerves serving the various pharyngeal muscles. The system originates in a main visceral ganglion (Fig. 4; v). which is situated just below the brain and is equipped with four pairs of symmetrical branches. The front pair of nerve trunks are short and rather thick. They lead to the lateral halves of the brain and their fiber masses fuse with the "punkt-substanz" of this part of the brain. The side branches leave the visceral ganglion at about its central and widest part and lead to the base of the œsophageal connectives. Near where these nerves leave the visceral ganglion a pair of small nerves (Fig. 4; r) about .01 mm. in diameter branch off from the ventral side and extend caudad for a distance of about 2.5 mm. These nerves form an analogue of the complex labio-visceral nervous system found in Eunice. (Quatrefages; '44.) The two hind trunks branch out into the visceral nervous system proper, as diagrammed (Fig. 4). They go straight back, parallel, assuming a diameter of about .04 mm. About 1 mm. behind the visceral ganglion they branch into an outer (Fig. 4; m) and an inner pair (Fig. 4; u).

The outer pair form the maxillary nervous system. They bend ventrad and branch in a very complex manner on either side of the

denticular pouch, serving the complicated musculature of the four pairs of maxillæ.

The inner pair of visceral nerves form the superpharyngeal nervous system. Near where they branch off from the outer pair they partly anastomose, interchanging a few fibers, but with no attendant ganglionic structure. The anastomosis continues for a distance of .16 mm. and then the nerves separate, assuming a diameter of .02 mm. and run parallel about 2 mm. apart for a distance of 1.3 mm. As they do this they bend dorsally so that they are deeply embedded in the upper wall of the denticular pouch and are quite dorsad of the maxillary musculature. This brings them to where the intestine folds off from the dorsal side of the denticular pouch. The nerves bend still more dorsad and become embedded in the intestinal epithelium. Here they become enlarged by ganglion cells and separating (Fig. 4; p), go around the mouth of the intestine proper and come together in the ventral wall of this structure. Just before their second anastomosis they send off two branches into the lateral and dorsal walls of the intestine. These nerves and the one into which the main pair fuses extend back along the intestinal wall for a short distance.

An interesting observation was made on the muscle which acts on the mandibles. It is a long spindle-shaped muscle reaching from the back of the pharynx to the mandibles. These bifurcate black chitinous plates are in apposition to the slit (Fig. 4; 6), whose walls are armed with the maxillæ and form the denticular pouch. The mandibles are bound to the walls of this slit by small muscles used in prehension. Now the members of this group that has the denticular pouch do not completely evert their pharynx in the act of prehension. They merely, from what observations I have been able to make on the Eunicidæ and on this form, push out the mandibles and the forceps jaw of the maxillæ. There is no proboscoideal musculature, such as is found in Phyllodoce, Glycera and Nereis, which functions from the inside and by contracting, turns the proboscis inside out. To take the place of the muscles which evert the proboscis by contracting and pulling it out we have in this form a muscle which, acting on the mandible forces this and the forceps teeth of the maxillæ out and does so, paradoxical as it may seem by

expanding. The fibers in this muscle, instead of running from the origin to the insertion of the muscle as a whole run dorsoventrally from wall to wall so that any stimulus acting on the nerve which supplies this muscle and causing the fibers to contract would cause the muscle to become rigid, of less diameter and of greater length. Since the origin of the muscle is in the back part of the pharnyx and since this organ is bound to the body wall by connective tissue and muscles, the "expansion" of the mandibular muscle must force the mandible forward and with it the forceps teeth of the maxillæ, which are closely bound to it. This action extrudes the teeth and a secondary reflex seems to be established that causes them to be snapped together forcibly soon after they are extruded. This reaction is carried on with such vigor that I have known eunicids to bite themselves into two or three pieces while dying in fixatives.

The advantage of this extrusion system over the more primitive proboscoideal eversion found in the forms without the denticular pouch can be seen in the quickness of the reaction, its superior vigor and the fact that the teeth are extruded first rather than as a final consequence of the comparatively slow eversion of a soft fleshy proboscis.

SUMMARY

1. The annelid, *Aracoda semimaculata,* is a highly specialized and evolved member of the lumbriconereidæ, inhabiting the mussel beds near Laguna.

2. Reconstructions were made stereographically as described in this paper.

3. The brain is very complex and highly specialized sensorially. It is divided into the sensory, connective, nuchal and visceral systems, is symmetrical and has a *central* tubal cavity running through the lower part of the main cross-connective portion of the brain, from front to back, parallel to a cavity which is partly filled with muscles and glands, and runs between the visceral ganglion and the main brain and forward between the dorsal and ventral lobes of the fore brain. This *central* cavity, taken together with the very complex and convoluted olifactory forebrain presents an appearance which seems quite similar to that described by Patten in *Limulus* and other invertebrates, but which can probably be best explained

as a mere functional adaptation rather than as a phenomenon of phylogenetic importance.

A. The sensory system is composed of the entire surface portion of the brain, i.e., those parts underlying the surface of the prostomium. The forepart of the brain is subdivided into fourteen to sixteen slender lobes of sensory cellular and inside fibrilar tracts. The sensory cellular tracts are not confined to the lobes in front, but extend all over the brain and give off fibers which connect with the subcuticular sense cells or go directly to the cuticle as sense fibers.

B. The main or cross-connective part of the brain consists principally of "punkt-substanz" with dorsal sense cells.

C. Eyes are four in number, the central pair being degenerate close to the surface of the prostomium, and lacking in lense structure. The lateral pair are well-developed but buried deeply in the prostomium and so inverted that the lens is inside and the pigment outside. Neither pair of eyes can be regarded as functional in the adult.

D. The circum-œsophageal connectives branch on each side into a dorsal and ventral ramus. This is analagous to the phenomenon found in *Nephtys* where the ocular and the surface sensory parts of the brain are separate structures.

E. The nuchal ganglia, extending to the rear from the dorsal part of the main brain are connected with a more or less rudimentary organ which is doubtfully a functional otocyst.

F. The subœsophageal ganglion and nerve cord are of the usual annelid form.

G. There is one segmental nerve extending around the body to a small pedal ganglion, whence it branches into two nerves, a pedal and a dorsal. The former gives rise to a motor notopodial branch and a sensory neuropodal branch. The latter is both motor and sensory in its distribution.

H. The visceral system consists of a labial, maxillary and a superpharyngeal system.

(a) The labial system is degenerate from the much more complex system in *Eunice,* or even in the much more closely related *Lumbriconereis*. It consists of a pair of small short nerves running

down the lateral and ventral walls of the œsophagus and originating in the lateral nerves of the visceral ganglion.

(b) The maxillary and superpharyngeal system originate in the main visceral ganglion which is situated just below the brain. The maxillary system branches repeatedly and serves the complex maxillary musculature. The superpharyngeal system goes straight back to where the intestine folds off. Here it developes a pair of slender ganglia which form a nearly complete circuminestinal ring and send off branches to the wall of the intestine.

4. The muscle which causes extrusion of the teeth is attached to the mandibular plates. It is a spindle-shaped muscle but acts by an increase of length instead of a contraction as is usual in muscles of this shape. This expansion is possible through the fact that the muscle fibers run across the muscle instead of from origin to insertion, and from the fact that the whole muscle is enclosed in a thick envelope of tough connective tissue, which holds the muscle rigid when a contraction of the fibers lessen the diameter and increase the length of the muscle. This adaptation seems to render prehension more efficient.

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(Contribution from the Zoological Laboratory of Pomona College)

EXPLANATION OF FIGURES

Figure 1. Stereographic reconstruction of the prostomium showing the position of the brain inside of it and the position of the fiber tract inside of the brain. The prostomium is shaded light, the brain darker and the fiber system darkest. The prostomial sensory branches are not shown. ×50.

Figure 2. Photograph of a wax reconstruction of the brain, showing the visceral and nuchal ganglia darkened. The two hundred odd prostomial sensory branches are shown in this reconstruction. ×40.

Figure 3. Diagram of the distribution of a segmental nerve.

Figure 4. Stereographic reconstruction of the ventral side of the brain and of the visceral nervous system. ×40.

Figure 5. Cross section through the front part of the prostomium cutting through the front lobes of the brain. ×50.

Figure 6. Cross section of the main cross-connective part of the brain showing the eye, the visceral ganglion and the canalicula that runs through this part of the brain. ×50.

Figure 7. Cross section of the brain in front of the main cross-connective part where it has divided into two lateral halves. ×50.

Figure 8. Cross section through the ventral nerve cord near where the segmental nerves come off showing giant cells. ×50.

Figure 9. Cross section of the above between the origins of these nerves. ×50.

Figure 10. Enlarged view of the connection of one of the lobes of the fore brain with the subcuticulum. ×250.

Figure 11. Giant cell and surrounding tissue. ×250.

Figure 12. Subcuticulum showing sense cells, mucous cells and regular subcuticular cells. ×500.

Figure 13. Cross section of nuchal ganglia. ×50.

Figure 14. Diagram of stereographic reconstruction, as described herein of two concentric cylinders; (a) is the first step, showing the cylinders with the topographical reconstruction lines; (b) is the orientation guide, and (c) is the shaded interpretation of (a).

MEANING OF THE LETTERS

(a) parapodia, (b) lateral brain lobes (c) frontal brain lobes, (d) brain cells, (e) fiber tracts, (f) large brain cells, (g) giant cells in ventral cord, (h) mucous gland cells, (i) nuchal ganglia, (j) subœsophageal ganglion, (k) pedicle of neurocord, (l) muscle tissue, (m) outer or maxillary nervous system, (n) inner or superpharyngeal nervous system, (o) maxillary slit opening into denticular pouch, (p) ganglia forming circumintestinal ring, (q) cavity which separates the dorsal from the ventral parts of the brain, (r) labial nerves, (s) subcuticular cell, (t) mucous gland cell, (u) sense cell, (v) visceral ganglion, (w) neural canal.

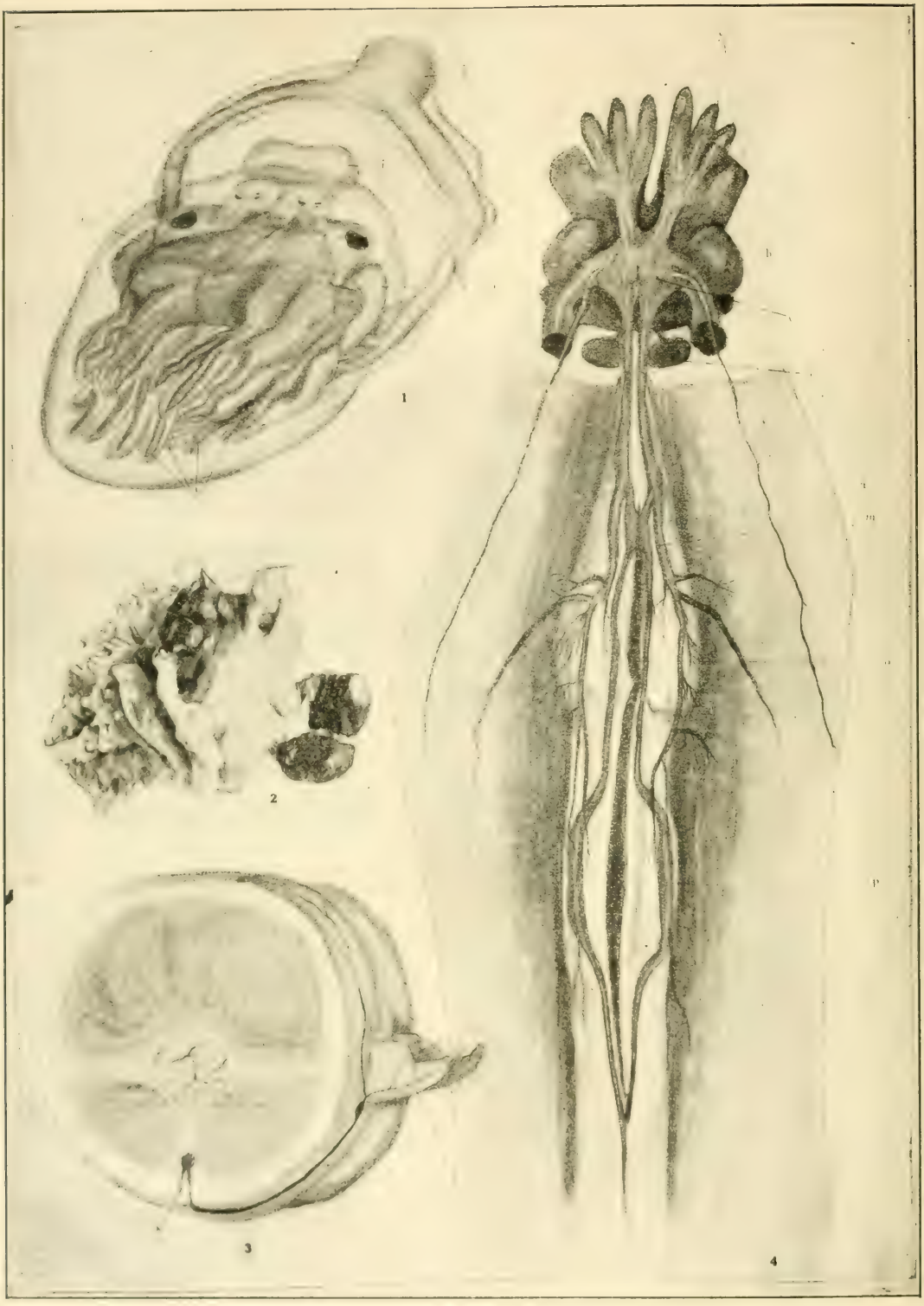
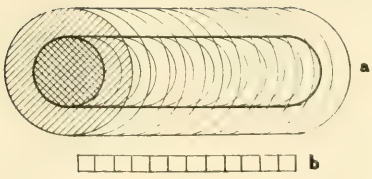
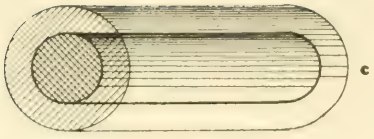
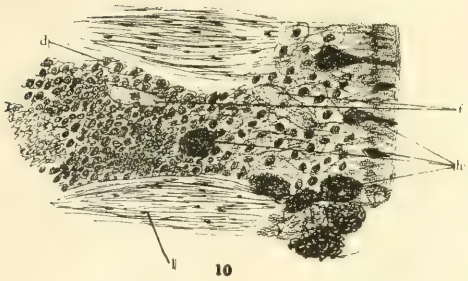
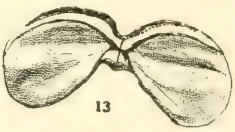


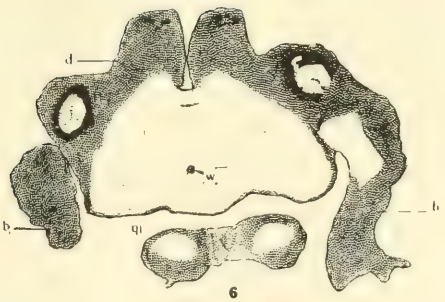
Plate I











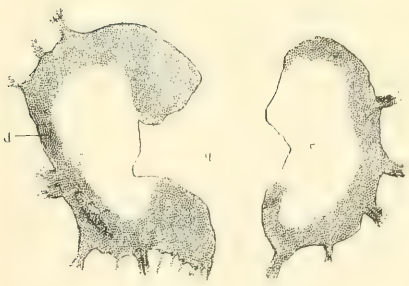


Plate II

The Central Nervous System of the Amphipod Orchestia

William A. Hilton

Numerous specimens of *Orchestia traskiana* Stim. were collected at Laguna Beach. Some were preserved whole, from others the central nervous system was studied in position or removed in one piece and stained and sectioned or mounted whole. For whole mounts some carmine stain or a light hermatoxylin coloration seemed best. For sections a copper hematoxylin was used with good results.

The brain occupies the forward portion of the head with large branches or lobes to the compound eyes which are somewhat dorsal and caudal from the brain as it lies in the head. Large nerves to the antennæ and smaller ones to the antennules cannot be seen from above as they run from near the connectives in a more ventral and caudal region. The brain is held in place by a band of tissue which perforates it near the center. In the figure the brain is not shown in the normal position. It is pulled out so as to show its parts better. The connectives join the rather small first ganglion, running almost ventrally when not displaced. Including this ganglion there are eight large thoracic ganglia and four small abdominal centers, the last of which is a little larger than the other three.

In whole mounts the brain does not show well. The ventral ganglia from surface views are found to contain a coating of large and small cells, especially on the ventral sides. Some of these are shown in the figures, which give views of a large and a smaller ganglion at one optical section. There are several layers of cells and both large and small are numerous, the latter of several sizes very numerous. The general position of some of the larger cells is shown in the figures.

In section the brain is found to be chiefly composed of fibers and fibrils. Large strands of fibers run long distances and connect widely separated regions. No very large cells were found in the brain, such as found in the ventral ganglia. and no very marked central region of the brain was clearly seen. The cells as compared with

the fibers were rather few. Fibrils also were evident, but could not be traced far. Cell groups were most marked in the posterior and lateral regions and fibers from these and to these could be followed as individuals for long distances. Posterior cells were especially numerous connected with the eyes and other parts. The ventral ganglia present no unusual structures in section. In two of the upper ganglia studied there seem to be in each at least two masses of cross fibers or communications.

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(Contribution from the Zoological Laboratory of Pomona College)

EXPLANATION OF PLATE

Figure 1. Central nervous system of *Orchestia*. ×10.
Figure 2. Surface view of one of the thoracic ganglia. ×75.
Figure 3. Surface view of one of the abdominal ganglia. ×75.
Figure 4. Longitudinal section through the brain. Caudal end to the top. ×75.
Figure 5. Longitudinal section of the brain; same as Fig. 4 but deeper. ×75.
Figures 6 and 7. Longitudinal sections of the second ventral ganglion. Caudal end at the top. ×75.
Figure 8. Longitudinal section through the first ventral ganglion. Caudal end at top. ×75.